

REMARKS

Claims 1-4 and 6-8 are presently pending in the application.

Claim 5 has been canceled and the subject matter thereof incorporated into claims 1 and 8. No new matter has been added by these amendments.

The Examiner has again rejected claims 1-8 under 35 U.S.C. §102(e) as being anticipated by each of U.S. Patent No. 6,358,648 of Hayashi et al. (“Hayashi”) and U.S. Patent No. 6,083,642 of Kato et al. (“Kato”). Applicants respectfully traverse these rejections and the arguments in support thereof for the reasons set forth in the previous Amendment, which Applicants rely upon in full, and for the additional reasons set forth below, and respectfully request reconsideration and withdrawal of the rejections.

Rejections Under §102(e) Based on Hayashi and on Kato

The Examiner’s arguments in support of his rejections based on Hayashi and on Kato are identical to those in the previous Office Action and will only be summarized here for convenience. Briefly, the Examiner contends that Hayashi teaches all of the attributes of the claimed positive electrode active material either explicitly (such as elemental composition and mean particle size) or inherently. Specifically, the Examiner takes the position that since the positive electrode active materials disclosed by Hayashi and the present application have similar chemistry and manufacturing procedures, properties of the Hayashi material which are not disclosed, such as BET surface area, particle size distribution and full width at half maximum of a particular crystallographic orientation, are inherent.

Similarly, the Examiner maintains that Kato also teaches or suggests all of the claimed elements, including a positive electrode material for an alkaline storage battery comprising nickel hydroxide particles and a higher cobalt oxide, in which the NiOH particles have the claimed particle size and surface area. The Examiner takes the position that other properties of the material, such as particle size distribution and full width at half maximum of a particular crystallographic orientation, are inherent, given that the positive electrode active materials disclosed by Kato and the present application have similar chemistry and manufacturing procedures.

Applicants previously argued that the reaction conditions (particularly the starting temperature of the sulfate solution and the degree of stirring) in the cited references are different from those in the present invention, leading to powders having different physical characteristics, and that it is difficult to obtain a mean circularity of nickel hydroxide powder equivalent to 1. The Examiner responds that the stirring rate for the material in Example 1 should be interpreted as “moderate” as opposed to “done” (as in the Table in the previous response), because the stirring rate in the Comparative Example is half that of the solution in Example 1 (see pages 24-25). Since the solution temperature of Comparative Example 1 is allegedly unclear, the Examiner argues that it would not be unreasonable to suggest that the temperature is close to room temperature, namely 20-25°C, and that the starting temperature of the solutions would be of little significance, since the reaction vessel temperatures of the three examples are all kept at 35°C. Accordingly, the Examiner concludes that the only result effective variable is the rate of stirring in the reaction vessel. The application allegedly fails to quantitatively state the rate of agitation in the reaction solution, but rather recites that the stirring rate is increased for the aqueous solution of sodium hydroxide in Example 2 as compared with Example 1, and that the stirring rate in Comparative Example 1 is half that used in Example 1.

Further, among the three powders, the resulting particle size, specific surface area, FWHM and (001)/(101) ratio all allegedly fall within the ranges recited in claims 1 and 8. The Examiner argues that the circularity is 0.95, 0.96, and 0.94 for powders produced in Example 1, Example 2, and Comparative Example 1, respectively, and that only the powder in Example 2 meets the remaining limitations, i.e., a mean particle circularity from not smaller than 0.95 to not larger than 1. The Examiner contends that the difference in circularity among the powders would be statistically indistinguishable if the standard deviation in the measurements is considered. The Examiner also argues that examination of the images of particles in Figures 3 and 4 of the application reveals substantial variations, such as shape and aspect ratio, in the oxide particles, and thus concludes that the physical properties of the respective powders are very similar and the claimed physical properties are inherent in the powder prepared by conventional practices.

Finally, the Examiner maintains that since Hayashi, Kato, and the present application utilize similar starting materials and processing procedures, the physical properties of the powders of interest would be inherent. Therefore, the Examiner still concludes that both Kato

and Hayashi anticipate all of the pending claims, which Applicants respectfully traverse for the reasons set forth previously and for the additional reasons which follow.

The present application is directed to a positive electrode active material for an alkaline storage battery containing a nickel hydroxide powder and/or a nickel oxyhydroxide powder, in which the positive electrode active material exhibits particular physical properties, and a method of making a positive electrode using such positive electrode active material.

Despite the Examiner's contention that the production method of the present invention and the methods of Kato and Hayashi are similar, there is a major difference between these methods, namely, neither Hayashi nor Kato describes or controls the temperature of the raw material active solution. Rather, according to Comparative Example 1 of the present application (which Applicants consider to be a conventional practice), Hayashi, and Kato, the temperature of the raw material solution simply depends on ambient temperature.

It takes at least several days and as long as several weeks to prepare spherical nickel hydroxide. Commercially, production facilities are operated consecutively and the temperatures of raw material solutions vary with changes in ambient temperature during the operating period (e.g., differences between day and night temperatures and temperature changes throughout a year). Such variations in the temperatures of raw material solutions also affect the production rate and the amount of crystal nuclei produced, which change the physical properties of the resulting powders. Accordingly, even if the temperature of the reaction vessel is controlled, it is still important to control the temperature of the raw material solution and is essential for the Examples of the present application to maintain the raw material solution at a constant temperature.

Examples 1 and 2 and Comparative Example 1 demonstrate that powder of high circularity may be obtained by maintaining the raw material solution at a constant temperature and by stirring the solution in the reaction vessel relatively vigorously. By examining the images of the particles shown in Figures 3 and 4 of the present application, which reveal particle shapes and aspect ratios, the Examiner concludes that since there are substantial variations, the physical properties are very similar and the claimed properties are inherent in the conventional particles. While not completely understanding the Examiner's argument, Applicants agree that it can be seen from Figures 3 and 4 that the particles have different circularities. However, the Examiner's assertion that the substantial variations, such as the aspect ratio, indicate that the

physical properties of the particles are very similar, is not based on the measuring method or definition of circularity described in the application (see page 13, line 13 to page 15, line 12). This method, which relies on projected images of captured particles, is more precise than the Examiner's measurement, which relies on the aspect ratio. Consequently, when using the method described in the application, the powders of Examples 1 and 2 and Comparative Example 1 exhibit differences in circularity, even if the standard deviation is taken into account.

Independent claims 1 and 8 recite that the number of particles having a circularity of not larger than 0.85 accounts for not more than 5% of the total particles in the active material. This property is significant because when the circularity is controlled in this way, the resulting positive electrode material paste exhibits stable properties. Therefore, the amounts of dispersion medium, thickener, etc. which must be added to the active material are reduced, resulting in an increased active material density in the electrode (page 16, lines 7-18). Additionally, as described at page 15, line 22 to page 16, line 6, "when the number of particles having a circularity of not larger than 0.85 accounts for more than 5% of the number of total particles, the capacity of the positive electrode or the cycle life of the battery may be decreased." In other words, when the number of particles having a circularity of not larger than 0.85 accounts for 5% or less of the total number of particles contained in the active material, the positive electrode active capacity, as well as the cycle life of the battery, can be maintained at a high level. Specifically, as shown in Table 1 and described at page 38 of the application, batteries having higher capacity and longer cycle life are obtained by improving both the particle circularity and the particle size uniformity of the active material.

In order to control the mean particle circularity to not smaller than 0.95 and to limit the number of particles having a circularity of not larger than 0.85 to not more than 5% of the total particles, it is necessary to maintain the temperature and pH of the reaction vessel and the temperature of the raw material solution supplied to the reaction vessel at constant levels. In addition, the solution in the reaction vessel needs to be stirred vigorously, as described in Example 2. While not described quantitatively, the stirring rates utilized in the Examples of the present invention are different from that in Comparative Example 1. Specifically, the rate in Example 1 is twice that of the rate in the Comparative Example, and the rate in Example 2 is greater than that of Example 1. Despite the importance of the rate of stirring, there is no absolute

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rate which is required. Rather, the stirring rate is a parameter which is determined on a case by case basis, depending on the size of the reaction vessel and the amount of solution to be stirred.

As an aside, the Examiner states that only the powder of Example 2 has a mean particle circularity from not smaller than 0.95 to not larger than 1. However, the powders of Examples 1, 3, and 4 also have mean particle circularities within the range (0.95, 0.97 and 0.96 respectively, as described at page 27, line 4, page 28, line 10, and page 29, line 5). Only the Comparative Example, which has a mean particle circularity of 0.94, is not within the claimed range.

Finally, Kato and Hayashi disclose powders having a mean particle circularity similar to that of the powder of comparative Example 1 of the present application. However, even if the mean particle circularity of the powders of Kato and Hayashi is maintained at the same level as that of the powder of Example 1 of the present application, the number of particles having a circularity of not larger than 0.85 would be more than 5% of the total particles because (a) the temperature of the raw material solution is not kept constant, and (b) the solution in the reaction vessel is not stirred relatively vigorously. Accordingly, neither Kato nor Hayashi teaches the claimed invention and the powders of Hayashi and Kato would not inherently exhibit the claimed properties. Therefore, neither Hayashi nor Kato anticipates the pending claims.

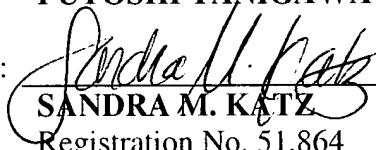
In view of the above Amendments and Remarks, Applicants respectfully submit that the pending claims are patentably distinct over the prior art of record and in condition for allowance. A Notice of Allowance is respectfully requested.

Respectfully submitted,

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Enclosure: Request for Continued Examination